A STUDY OF THE INCREASE IN HIGH DENSITY LIPOPROTEIN CHOLESTEROL THROUGH AN INCREASE IN THE FREQUENCY OF EXERCISE STRESS

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INTRODUCTION

Many researchers[1)3)4)6)7)8)9)10)11)12)13)14)] have already represented the effects of chronic exercise on blood lipids. According to these studies, individuals who have a high level of blood lipids usually decrease low (LDL-C) and very low density lipoprotein cholesterol (VLDL-C) levels and increase high density lipoprotein cholesterol (HDL-C). However few seem to have done any research on the effect of splitting the duration of exercise upon blood lipids and cardiovascular endurance. The result of the study this researcher and others conducted was presented orally at the 27th annual meeting of American College of Sports Medicine in 1980. The research study indicated that as long as individuals ran the same distance with identical intensities and frequencies, the changes on blood lipids, maximum oxygen consumption, maximum heart rate and body composition were not statistically different among groups, even when the duration was split from, for example six miles once a day to three miles twice a day or two miles three times a day. Among all dependent variables, only HDL-C increased significantly in the group which ran three times a day.

The purpose of this study is to investigate further the phenomenon of increase in HDL-C through an increase in the frequency of exercise stress by indicating not only just HDL-C value but a safety index, HDL-C/LDL-C value, and HDL-C/total cholesterol (TC) value. The phenomenon may not be just accidental because not only a group which ran three times a day increased HDL-C statistically but a group which ran twice a day increased HDL-C more than a group which ran once a day even though the increase the latter two groups showed was not statistically significant.

MATERIALS AND METHODS

Sixty untrained male students (age: M = 21 yrs) were randomly assigned to either the control group or to one of the three experimental groups as follows: Group A - Subjects in this group ran three miles once each training day for the first three weeks, four miles once each training day for the next three weeks, and six miles once each training day for the next four weeks. Group B - Subjects in this group ran 1.5 miles in the morning and 1.5 miles in the evening each training day for the first three weeks, two miles in the morning and two miles in the evening each training day for the next three weeks, and three miles in the morning and three miles in the evening each training day for the next four weeks. Group C - Subjects in this group ran one mile in the morning, one mile around noon, and one mile in the evening each training day for the first three weeks, 1.3 miles in the morning, 1.3 miles around noon, and 1.3 miles in the evening each training day for the next three weeks, and two miles in the morning, two miles around noon, and two miles in the evening each training day for the next four weeks. Group D - Control - Subjects in this group were instructed to engage in no additional physical activity during the study. The

mileage assigned to groups and the progression in the various groups was tested in a 7.5 week pilot study. Subjects were assigned to the progressive distance groups described above as well as a group running six miles a day from the beginning. From the pilot study, it was determined that the progressive program was easier for subjects to accomplish.

All of the exercise group trained on Monday, Wednesday, and Friday (three days a week) for ten weeks from mid-January through the beginning of April, 1979. Training intensities were 80 percent of each subject's maximal heart rate. An accurate daily log of the subjects' training was kept and the training was supervised by the researcher. Training was done on the indoor track at Brigham Young University (BYU).

Fasting blood samples were collected by laboratory technicians and analyzed at LDS Hospital in Salt Lake City. Two tests, tests 1 and 2, were conducted for both the exercise groups and the control group. Test 1 was conducted before the training session (Pre-test). Test 2 was conducted after the training session (Post-test). Dependent variables in this study were TC, total triglyceride (TG), HDL-C, LDL-C, VLDL-C, HDL-C/LDL-C and HDL-C/TC.

Any who were currently on some type of regular exercise program were excluded. All of the subjects have never had any experience of drinking or smoking. These subjects have to be chosen for this research because drinking and smoking influence the level of blood lipids.[5] Differences in blood lipid also exist between males and females.[2]

RESULTS

Of the sixty original subjects seven did not successfully complete the ten weeks of the endurance training due to withdrawal from school, injury from another activity, or illness. The results are based on data from the remaining 53 subjects.

According to Table 1, differences for treatments of all variables in this study were not significant. Only HDL-C showed a significant difference between pre- and post-tests.

TABLE 1. Summary of the analysis of variance for all dependent variables (mg%)

Variable	Source	df	Mean Square	F	Sign. Level
TC	Tt	3	741.740	0.560	N.S.
	Te	1	0.009	0.000	N.S.
	Tt.Te	3	188.440	1.291	N.S.
TG	Tt	3	1221.700	0.678	N.S.
	Te	1	1202.300	2.106	N.S.
	Tt.Te	3	570.810	1.026	N.S.
HDL-C	Tt	3	138.020	1.522	N.S.
	Te	1	154.570	13.270	.05
	Tt.Te	3	11.648	0.644	N.S.
LDL-C	Tt	3	610.520	0.549	N.S.
	Te	1	135.850	0.711	N.S.
	Tt.Te	3	191.000	1.776	N.S.
VLDL-C	Tt	3	52.242	0.820	N.S.
	Te	1	46.226	1.861	N.S.
	Tt.Te	3	24.846	1.128	N.S.

(n = 53)

Tt: treatments
Te: tests
Tt.Te: interaction between the test periods and treatments

Table 2 presents the changes of HDL-C values between the test periods in all groups. As seen in the table, all of the groups in creased the HDL-C values. However, only Group C's increase was significant.

TABLE 2. Changes of HDL-C values ($mg^{\%}$) between the test periods

	Group A (n=14)	Gruop B (n=13)	Group C (n=12)	Group D (n=14)
Pre	46.000 ±7.131	45.566 ±5.678	46.679 ±6.395	50.286 ±6.755
Post	47.571 ±6.726	47.720 ±7.023	51.179 ±8.061	52.000 ±8.519
Diff.	1.571	2.154	4.500	1.714
T	0.977	1.272	2.457*	1.066

* significant difference at the .05 level

Table 3 summarizes the analysis of variance for differences of treatments on HDL-C/LDL-C and HDL-C/TC values. As shown in the table, none of the differences were significant.

TABLE 3. Summary of the analysis of variance for differences in treatments on HDL-C/LDL-C and HDL-C/TC values

	HDL-C/LDL-C	HDL-C/TC
SS (bg)	0.0317	0.0049
SS (wg)	0.5453	0.1051
df (bg)	3	3
df (wg)	49	49
MS (bg)	0.0106	0.0017
MS (wg)	0.0111	0.0022
F	0.9501	0.7680
Sign. Level	N.S.	N.S.

(n=53) bg: between groups
wg: within groups

Tables 4 and 5 illustrate changes of HDL-C/LDL-C and HDL-C/TC values between the test periods in all groups. As seen in the tables, none of the changes were significant.

TABLE 4. Changes of HDL-C/LDL-C values (mg%) between the test periods

	Group A (n=14)	Group B (n=13)	Group C (n=12)	Group D (n=14)
Pre	0.4916 ±0.1360	0.4970 ±0.1486	0.5090 ±0.1253	0.5175 ±0.1432
Post	0.5200 ±0.1064	0.5724 ±0.1812	0.5218 ±0.1023	0.5356 ±0.1450
Diff.	0.0284	0.0754	0.0128	0.0181
T	0.5927	1.1151	0.2497	0.3193

(None of the T-ratios are significant)

TABLE 5. Changes of HDL-C/TC values (mg%) between the test periods

	Group A (n=14)	Group B (n=13)	Group C (n=12)	Group D (n=14)
Pre	0.2884 ±0.0517	0.2929 ±0.0578	0.2955 ±0.0497	0.3166 ±0.0623
Post	0.3015 ±0.0412	0.3178 ±0.0628	0.3116 ±0.0426	0.3150 ±0.0614
Diff.	0.0131	0.0249	0.0161	-0.0016
T	0.7168	1.0096	0.8145	0.0651

(None of the T-ratios are significant)

All of the calculations in this study were done by using computers in the Department of Statistics, BYU and in the Faculty of Education Fukui University.

DISCUSSION

After confirming that pre-test values were not significant different among all groups in all variables by the method of analysis of variance, the data in this study were calculated to investigate differences among groups. As previously indicated, HDL-C values increased significantly in Group C which ran one-third of the distance each training session for three sessions daily. A similar result could not be obtained concerning HDL-C-LDL-C and HDL-C/TC values. In other words, both of the values did not significantly increase in all groups due to the 10 week exercise and differences of the increase were not significant among groups. The reason is probably that energy cost for running is the same as long as individuals run the same distance with identical intensities and frequencies even when the duration is split. Increase in HDL-C, therefore, was not related to changes in LDL-C and TC values but the HDL-C increased independently. Findings in this study seem to indicate that the increase in HDL-C in Group C was accidental rather than inevitable. However, a further research study is necessary to clarify if HDL-C inevitably increases through an increase in the frequency of exercise stress.

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